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A Study of the Short Term Agricultural User Adjustment Problems Associated with Major Pesticide Regulatory Restrictions Executive Summary

CONSAD Research Corp, Pittsburgh, Pa

Prepared for

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EXECUTIVE SUMMARY

A STUDY OF THE SHORT TERM AGRICULTURAL USER ADJUSTMENT PROBLEMS ASSOCIATED WITH MAJOR PESTICIDE REGULATORY RESTRICTIONS

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDE PROGRAMS
CRITERIA AND EVALUATION DIVISION
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Prepared for:

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Crystal Mall Building Two, Room 815
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PREFACE

CONSAD Research Corporation prepared this report during the period of July 1, 1975 to November 30, 1976, under Contract Number 68-01-1917 for the Criteria and Evaluation Division, Office of Pesticide Programs, Environmental Protection Agency. The field work phase of the study (on which this report is based) took place during the period of January 1, 1976 to March 15, 1976. Dr. Robert R. Reynolds was the EPA Project Officer.

Mr. Alan Bernstein, Dr. Douglas Stewart and Mr. Robert Lowrey, were the principal CONSAD personnel assigned to this project. Mr. Roger Mayland and Mr. Larry Koch performed the field interviews during the study.

Dr. Herbert Cole, the Pennsylvania State University, Dr. Gerald Klonglan, Iowa State University, and Dr. Jerry Stockdale, University of Northern Iowa, were the principal consultants.

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Finally, and most importantly, a special thank you to all those individuals -- farmers, pesticide dealers, implement dealers, local financial institutions, professional scouts, professional applicators, local educators, chemical company representatives, extension agents, ASCS directors, etc. -- who provided us with information while we were in the field.

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ABSTRACT

The objectives of this study were to identify the range of short-term (tentatively defined for purposes of this study as three years) "on the farm" user adjustment problems associated with major pesticide regulatory decisions, as well as to explain user problems and responses to those problems. The existing knowledge base relative to these phenomena was not one which could support a rigorous, quantitative study.

Not knowing the potential problems or the explanatory mechanisms which could emerge required that the data collection activities be extremely flexible and utilize a case study ("ethnographic") approach. As distinct from the standard social science survey in which all questions are known prior to initiation of field work, the case study or "ethnographic" approach adopted here was one in which field activities for the second week were planned by the field observer and field director on the basis of data collected and interpreted during the first week (and so on throughout the field work phase).

Two case studies were performed, each focusing on a particular pesticide/crop/pest problem combination. Criteria for the selection of study pesticides and study crops were identified. Once these criteria were applied, the two case studies emerged -- one focusing on field corn where aldrin/dieldrin and chlordane/heptachlor were used to control the black cutworm and the other focusing on cotton where DDT was used to control the tobacco budworm. The study site for each case study consisted of two counties, which were selected in light of the pesticide/crop/pest problem combinations described above.

The field work phase (i.e., the data collection phase) began in early January, 1976 and lasted ten weeks. Once the field work phase was completed, post field work activities took place including the analysis of the data generated in the field and the writing of the final report.

In reviewing the farmer adjustment responses and problems and the influential forces associated therein, a number of conclusions were found to be pertinent for providing EPA with a better understanding of the process associated with replacing a banned pesticide in the short term (i.e., within a period of three years).

- Although farmers may become aware (i.e., "hear something") of a pesticide regulatory action near the time Federal decisions are made via the news media, they do not necessarily act on this information (i.e., take the message seriously, attend to it, solicit and receive detailed information, etc.). Indeed, the regulatory restriction does not become problematic until carry-over supplies of the banned pesticide become scarce. Thus, little experimenting with alternatives is done prior to this time and no preparatory or anticipatory adjustments are made.

- The initial user adjustment response amongst farmers is usually an attempt to maintain their current pest control practice and hence they continue using the banned pesticide. Indeed, many farmers augment their supply by stockpiling and are encouraged to do so through advice received in the community-based institutional service network.

- User adjustment responses that simply entail the substitution of the banned pesticide with a new chemical are also fairly common, but the adoption of new pest control practices not utilized in the past (e.g., alternate crops, intensive use of scouting with contingent use of rescue insecticides, etc.) are met with greatest resistance by the farmer and are usually only adopted by the larger, more established and higher resource farmers in the short term.

- These user adjustment responses are not without their reported difficulties by farmers. Most of their concerns center around matters that could inhibit yield and profit; less concern for health or environmental side effects is apparent. The following user concerns are in evidence: pesticide shortages, increased cost and reduced efficacy of alternate chemicals (the latter partially caused by improper application) resulting in increased production costs, reduced yields, reduced income and increased debt; allergic reactions and the lack of institutional services for alternate crops; and institutional constraints and prior practices precluding adjustment responses involving new pest control practices (e.g., intensive use of scouting).

- Farmers look to an institutional service network in their surrounding community for alternate courses of action when faced with replacing a banned pesticide (e.g., the extension service, the agricultural experiment stations, chemical companies, pesticide dealers, lending organizations, professional scouts, neighbors, friends and relatives, etc.). However, institutional constraints which impede responsiveness to the pesticide regulatory action can preclude otherwise possible responses by the farmer.

- A farmer's past practices (i.e., tradition) and his beliefs about what kinds of pest control strategies are effective for a particular pest, influence his adjustment responses in the sense that they restrain the range of attractive options.

- Financial resources (e.g., cash and/or credit) also constitute a significant attribute with respect to a farmer's response and problems associated therewith. That is, those farmers that can weather one or two poor crop years while the community based support institutions seek viable alternatives to the banned pesticide are least likely to have serious adjustment problems.

- Noncontrollable confounding conditions such as inflation, the weather, fluctuating market conditions for alternate crops, prior and expected levels of pest infestation, and pesticide shortages caused by raw material shortages (e.g., a petroleum crunch), all influence both a farmer's response to a pesticide regulatory decision and the subsequent problems that may develop. Nevertheless, the nature of the relationships between the farmer and the various support organizations will, to varying degrees, mitigate or soften the effects of these otherwise uncontrollable conditions in the production operating environment.

- Hence, the magnitude or seriousness of a farmer's adjustment problems (i.e., the degree to which a particular adjustment problem affects his ability to adapt to a new pest control option with confidence)

is influenced by both his personal resources (i.e., past practices to pest control, financial resources, information seeking activities, managerial skills, and friendship ties with pesticide dealers) and the ability of the institutional service network to provide timely, supplementary resources for responding to a regulatory action. Curiously, the extent of interphase of these two resource factors means that adjustment problems can be equally serious for different farmers in the same geographical locality.

In summary, a period of three years appears to be a reasonable definition for describing "short term" transitional user adjustment problems. This study found that during the first growing season affected by a regulatory action, many farmers will attempt to "buy time" by stockpiling the banned pesticide. For some farmers, such stockpiles may be sufficient to carry them through the second growing season as well. However, in the third growing season affected by a regulatory action, few carry-over supplies of a banned pesticide exist and, thus, most, if not all, farmers are forced to make an additional adjustment response. Nevertheless, the available response options (i.e., alternate pest control strategies), the extent to which each is chosen, and the difficulties anticipated in adopting each option are, of course, influenced by a complex set of personal and community institutional resource conditions. Therefore, the response options open to the farmer and adopted by him in the "short term" (i.e., three years) will vary both between farmers of the same commodity sector, as well as between farmers of different commodity sectors.

I. RATIONALE FOR THE STUDY

Under Public Law 92-516, the Environmental Protection Agency is charged with the protection of man and the environment from deleterious effects of pesticide use. However, the amended FIFRA (PL. 92-516) requires that decisions the Administrator makes governing the use of pesticides determined to produce "unreasonable, adverse" environmental effects shall be made with an awareness of the prospects for "unreasonable, adverse" social, economic and environmental effects resulting from the decision. Thus, if the substitute pest control procedures available present different health hazards or, if there are no substitutes available to maintain food and fiber production, then one problem is merely substituted for another.

Congress, in desiring to minimize the occurrence of such outcomes, has provided funds for the evaluation of problem pesticides and the consequences of various decision options for their use. The review program associated with the Substitute Chemical Program is a pivotal component of this policy thrust. Funds have been targeted in this program for the purpose of identifying pest control procedures that can feasibly substitute for problem pesticides, and for the purpose of evaluating evidence pertaining to probable short and long term effects of their use. However, information is not always available for certain classes of problems.

Data documenting short-term (tentatively defined for purposes of this study as three years)[a] transitional problems experienced by farmers faced with the problem of replacing a cancelled or suspended pesticide is one of the areas in which more knowledge is needed.[b] Short-term

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[a]Chosen because the DDT decision was three years old when this study was undertaken.

[b]This problem has been alluded to in past research and in previous pesticide regulatory decisions. For example, see Hyg Consultants, Farmer's Pesticide Use Decisions and Attitudes on Alternate Crop Protection Methods. Report prepared for the CEQ and the EPA, Contract Number EQC 317, July, 1974; National Academy of Sciences, Pest Control: An Assessment of Present and Alternative Technologies, (5 volumes), 1975; and Opinion of the Administrator, EPA, on the Suspension of Aldrin and Dieldrin, FIFRA Dockets Numbers 149 et. al., October 1, 1974.

user problems can become long-term problems for society, especially if major regulatory decisions are made without an adequate understanding of the scope and magnitude of problems.

The type and magnitude of farmer adjustment problems experienced were not well understood at the time the study was initiated, but were thought to possibly include shortages of substitute supplies, problems associated with the attainment of application skills, occupational health problems stemming from the use of unfamiliar products, etc.

Therefore, in order to upgrade the Environmental Protection Agency's capacity for identifying and understanding post-regulatory agricultural user adjustment problems and in order to provide direction to EPA in areas having optimal policy benefit, this study was undertaken.

II. PROJECT OBJECTIVES AND CONSTRAINTS

Within the limits imposed by the relative lack of knowledge regarding user response to pesticide withdrawals, this study was a developmental one and was viewed as one of discovery and exploration. That is, the objectives of this study were to identify the representative range of "on the farm" user adjustment problems associated with major pesticide regulatory decisions, as well as to establish a testable theoretical framework for explaining user problems and responses to those problems.

The primary focus of the study was on farmers of select commodities and the scope of work stipulated that two major crops be selected to further focus the study effort. Moreover, the contract stipulated that the study should be targeted to, but not necessarily confined to adjustment problems associated with decisions to cancel aldrin/dieldrin and chlordane/heptachlor. Overall farmer adjustment problems were to encompass a range of issues including managerial problems, resource shortages, poor results with substitute pest control procedures, new pest problems, crop failure, safety problems, etc.

Finally, the contract specified that the sampling design and data collection procedures be sufficiently flexible to permit development of a policy understanding of the user adjustment problems specific to various crop production systems, without sacrificing the precision necessary to identify response profiles of the most serious problems. In addition, the relationship between user behavior and the influence of local and extra-local institutional conditions to pesticide use and response to regulatory decisions were to be identified.

III. STUDY APPROACH

As stipulated in the project objectives, the focus of the present study was to identify the range of "on the farm" user adjustment problems associated with major pesticide regulatory decisions, as well as to explain user problems and responses to those problems. The existing knowledge base relative to these phenomena was not one which could support a rigorous, quantitative study.

Not knowing the potential problems or the explanatory mechanisms which could emerge required that the data collection activities be extremely flexible and utilize a case study ("ethnographic") approach. As distinct from the standard social science survey in which all questions are known prior to initiation of field work, the case study or "ethnographic" approach adopted here was one in which field activities for the second week were planned by the field observer and field director on the basis of data collected and interpreted during the first week (and so on throughout the field work phase). In addition, the effect of two case studies (one for each major crop selected to focus the study) on the dynamic nature of the project is significant for it allowed insights derived from one commodity to be explored through similar data acquisition procedures on the other.

Conjoined with this emphasis on flexibility was a planning approach which indicated a set of procedures and initial data sources. Of particular importance was the enumeration of non-farm sources of information. This methodological approach was supported by the overall conceptual orientation -- that the farmer exists within an institutional context which can serve as an important explanatory basis regarding the farmer's responses. A wholistic view of the social structure and process pertinent to the farmer's use of pesticides and exposure to the banning of a pesticide was sought. That is, those conditions (including the various institutional structures enmeshed in the agricultural community) that either alleviate or aggravate the user adjustment process were of concern in the study.

It should also be emphasized that this study is based on what respondents (farmers and others) reported, given that the thrust of the study was to discover and explain user adjustment responses and problems. These reports are, in turn, based on respondent's perceptions. Thus, the study is reporting on the perceptual world's of various actors in the crop production system. The implications should be clear: this

report was not to address the "real" or "objective" consequences of specific pesticide regulatory decisions and therefore, this study was not to be an assessment of the "real" impact experienced by farmers when faced with the banning of a particular pesticide. However, the important point to be recognized here is that "real" behavior and decisions are based on perceptions, whether valid or not, and thus are of utmost concern in policy decision making and program implementation.

In order to implement the above approach and fulfill the project requirements, a three phased effort was utilized. Pre-field work activities were first undertaken to select study crops and study sites in order to focus the field work phase. Utilizing the "ethnographic" approach, the field work phase was then implemented and involved the development of a field manual to guide the data collection activities, the selection, training, and installation of field observers, as well as the actual field work, i.e., data collection activities, which began in early January, 1976 and lasted ten weeks. Once the field work was completed, post field work activities took place including an initial coding, analysis and debriefing session, an analysis plan meeting, final analysis, and the writing of the final report.

Each phase is briefly discussed in the paragraphs below.

The three major pesticide regulatory decisions affecting agricultural production to date were chosen as study pesticides for this study, i.e., DDT, aldrin/dieldrin, and chlordane/heptachlor. The DDT decision was chosen because: (1) it was the first major pesticide decision to affect the agricultural community, and (2) since it has been in effect since December 31, 1972, it was thought that farmers would be able to relate some real adjustment experiences. The aldrin/dieldrin and chlordane/heptachlor decisions were chosen because: (1) they provided a contrast to DDT in that the decisions have not been in effect for as long (i.e., aldrin/dieldrin were suspended effective August 2, 1974 and chlordane/heptachlor were suspended effective July 29, 1975 for most uses and August 1, 1976 for corn), (2) given this fact, it was thought that these decisions would provide an opportunity to study early phases of the adjustment process directly in order to capture the formulative ingredients therein, and (3) aldrin/dieldrin were used by many farmers as substitutes for one another (hence the reason for including both decisions).

Using these three regulatory actions, two major crops -- corn and cotton -- were selected for in depth study as stipulated by the contract. Corn was chosen because: (1) the majority of all aldrin/

dieldrin and chlordane/heptachlor applied on crops have been used on corn* and (2) the black cutworm (a corn pest prevalent every year in various parts of the U.S.) is effectively controlled with these pesticides and suitable alternatives for this pest problem (i.e., pesticide alternatives having a similar cost and providing equal efficacy as these pesticides) are non-existent in the eyes of many corn farmers.** Cotton was chosen because: (1) almost all DDT applied on crops was used on cotton* and (2) farmers considered DDT to be an effective inexpensive control for the tobacco budworm, a cotton pest which has increased in recent years.***

The selection of study sites (i.e., two counties for each crop), primarily revolved around satisfying the two pesticide/crop/pest problem combinations delineated above, i.e., the use of aldrin/dieldrin and chlordane/heptachlor on corn where black cutworm problems typically exist and the use of DDT on cotton where tobacco budworm problems typically exist. Also of concern was the location of each set of counties, i.e., attempts to find adjacent counties for each crop were made to maximize the results given the resources available for field work. After carefully reviewing published reports and EPA in-house data, and after discussions with numerous state and county extension personnel, the following study sites were chosen: for corn - Fremont County, Iowa and Atchison County, Missouri, and for cotton - Richland Parish, Louisiana and Franklin Parish, Louisiana.

As described earlier, the approach adopted for the field work can most appropriately be termed "ethnographic". This required the preparation of a field manual to assure common understanding of the field related tasks to be undertaken by the field staff. The careful selection and training of field staff was also required. Selection of field staff was facilitated by "nominations" made by project consultants

*Andreatnas, P.A., Farmer's Use of Pesticides in 1971: Quantities, USDA, ERS, July, 1974.

**EPA Cancellation of Chlordane/Heptachlor: Economic and Social Implications, Economic Analysis Branch, Criteria and Evaluation Division, Office of Pesticide Programs, EPA, May, 1975; conversations held with extension personnel in Illinois, Indiana, Iowa, Missouri and Ohio prior to the field work phase.

***State of Louisiana's emergency request to use DDT in the 1975 growing season; conversations with Louisiana extension personnel prior to the field work phase.

located at universities. Telephone interviews were conducted with several candidates and final selection made only following face-to-face interviews. Both field people selected held social science degrees and had grown up in agricultural areas.

Following an intensive training session at CONSAD, the field director accompanied the field people into their respective geographic locations. In the case of cotton, prior to installation, the field director and field person spent two days in discussions with state research and extension personnel, followed by one day of interviews with extension staff in two parishes not subject to in depth study.

During the period of field work, the field director visited each site on a bimonthly schedule. Additionally, reports were submitted every Friday afternoon (both in writing and by telephone). Moreover, additional communications occurred when necessary to provide information to the field observers. In sum, very tight control was maintained over the very flexible design.

At the conclusion of field work, each field person spent several days with the field director in order to organize data files, code interview write-ups, note and fill data gaps, and formulate a series of descriptive propositions. Subsequently, a two day meeting was held at CONSAD, involving all project staff members (including field people from both sites), several project consultants and the EPA monitor. The outcome of this meeting was the intended analysis plan and structure of the final reports to be undertaken by the project and field directors.

IV. CROSS COMMODITY COMPARISONS

The purpose of this chapter is to provide a summary of some key similarities and differences found in the two crop studies performed, i.e., corn and cotton. First, pertinent crop production factors affecting user adjustment are discussed. This is then followed by a presentation of various institutional arrangements and activities found in the two study sites, including some implications for possible adjustment responses and problems.

A. Crop Production Factors Affecting User Adjustment

In comparing the two crop-pesticide-pest combinations that were utilized to focus the effort in this study (i.e., corn - aldrin/dieldrin and chlordane/heptachlor - black cutworm, and cotton - DDT - tobacco budworm), a number of significant differences emerge. First, not all corn farmers in the study site had black cutworm infestations and those that did have the problem typically did not have it on all of their corn crop since soil type is a key factor, i.e., black cutworms are found predominantly in gumbo (or alluvial) soil. All cotton farmers, however, were or had been plagued with the tobacco budworm over the past three years. Moreover, black cutworm control traditionally involved the use of preventive type insecticides, whereas tobacco budworm contol was addressed with a series of rescue treatments once a given level of infestation was evident. Finally, in general insect problems and the control of them have typically been more severe in cotton production; that is, a long history of pest control problems (e.g., insect resistance to pesticides) can be found in cotton production (of particular interest is tobacco budworm resistance to DDT), more so than in corn production.

Consequently, the chemical solution appeared to be the primary means of control by those corn farmers having black cutworm infestations as various preventive type insecticides were always available and were regarded as a highly effective means of control. In contrast, cotton farmers have found that sole reliance on insecticides did not adequately control their insect problems (e.g., the tobacco budworm) and preventive type insecticides could not be used. Rather, rescue type insecticides had to be used in conjunction with other crop production practices designed to determine and minimize insect populations (e.g., scouting, diapause control, use of beneficial insects, stalk destruction, etc.).

Weather conditions in each study site deserve mention as well as they affect the level of insect infestation. Dry weather for the past two years in the two corn counties studied has reportedly somewhat reduced the black cutworm infestation levels (and caused another problem - drought), whereas wet spring weather in the cotton counties in 1974 delayed planting and summer rains induced regrowth, thus making cotton extremely attractive to the tobacco budworm from mid August into September when their control is most critical. Moreover fall rains reportedly delayed harvesting and reduced pesticide efficiency. Thus, weather conditions in the cotton study site appeared to favor tobacco budworm infestations whereas this was not the case with black cutworm infestations in the corn study site.

Another area of variation lies in the mechanism utilized by farmers to determine the crops that they will grow. In the corn study site, a rotation plan of corn and soybeans (which dictates each crop in each field each year) appears to be a common practice,* although continuous corn is also grown. Alternative crops such as wheat and milo have also been planted recently, partially due to the aldrin/dieldrin and chlordane/heptachlor suspensions, but also because of the dry weather conditions (i.e., these crops are drought resistant). Thus, the rotation plan, the price and availability of fertilizer and pesticides, and the weather all play a part in the crop selection process. In the cotton study site, however, farmers reported that little crop rotation occurred. Some farmers grew nothing but cotton (i.e., they have grown cotton all of their lives and it is somewhat traditional), while others appeared to designate their better land as cotton land and the rest of their land (or most of it) as soybean land. However, shifting of crops (e.g., to less cotton and more soybeans) was reported, particularly in 1975, due to the favorable prices for soybeans compared to cotton, production costs of the two crops (soybeans are about half that of cotton according to the FHA), the price and availability of cotton insecticides, and the previous bad weather for cotton production.

Finally, it is important to note that many cotton farmers and others in the cotton site reported that once use restrictions on DDT were instituted (e.g., the use of DDT around dairy cattle was restricted by USDA in the late 1960's), they anticipated that further regulatory action against DDT would be likely. Such anticipation amongst corn farmers was not found to be present in the corn site for the aldrin/dieldrin and chlordane/heptachlor decisions, although use restrictions pertaining to milk and meat products were imposed by USDA in the late 1960's. A possible explanation is that a larger number of restrictions

*An important reason for this is that a corn-soybean rotation plan reduces the likelihood of corn rootworm problems, a common occurrance when continuous corn is grown.

were imposed on the use of DDT than on the use of aldrin/dieldrin or chlordane/heptachlor prior to EPA regulatory action to cancel and/or suspend these pesticides. Also, more publicity about the DDT use restrictions and DDT's harmful effects may be factors to explain this variation.

B. Institutional Arrangements and Activities

In each of the two study sites, a number of institutions were found to have an influence on a farmer's crop production practices, and more specifically his pest control practices. Moreover, comparison between these two sites indicated a number of significant differences related to the kinds and amount of information received by farmers from each source, which in turn have implications for adjustment responses and problems.

For example, the extension service in the cotton study site was found to play a very active role in the area of cotton insect control and sought to maintain direct contact with the farmer through the local extension activities. Thus, in addition to state and regional meetings for pesticide dealers, farmers, and others interested in cotton insect control, local agents hold special meetings for area farmers and maintain contact with them throughout the growing season via the local media. In contrast, the extension services in the corn study site, having recognized the close relationship that exists between the pesticide dealer and farmer regarding information about pesticides, hold regional and statewide meetings for pesticide dealers to distribute their pest control recommendations to them. At the local level, the county agents also work with the area pesticide dealers and are available to assist any farmer with any particular problem. They also coordinate educational activities through the local media. Emphasis is put on corn and soybean production (the two leading crops in the study area) and no massive efforts are made to reach every farmer; rather reliance is put on the pesticide dealer to transmit the university extension recommendations.

Closely related to the extension service activity is the agricultural experiment station activity. Indications were received that the aldrin/dieldrin suspension precipitated funding for black cutworm research and that prior to the suspension notice, little research was underway. Moreover, research entomologists did not think that heptachlor, an alternative to aldrin, would be suspended so soon after aldrin, leaving no preventive cutworm alternative to the farmer. Thus, the life cycle

of the cutworm is still not well understood and some feel they are still three or four years away. As a result, although alternatives to preventive cutworm insecticides are available (i.e., rescues), many experts in the study site feel they cannot be used effectively. In contrast to this situation, a rather sophisticated research entomology operation appears to be at work in Louisiana. Funding over the years has been adequate (including funds supplied by the state legislature in late 1974) for tobacco budworm research and the experiment station appears to have adopted a long range (5 to 10 year) perspective to cotton insect control with the hope of developing resistant cotton strains and earlier maturing varieties. Moreover, the experiment station, as well as the extension service, warned the farmer of pest resistance to DDT and its likely cancellation, as early as 1971.

Variations in the research activities undertaken by the chemical companies were also noted. For the black cutworm, little research was found to be underway on developing new preventive type insecticides as the chemical companies appeared to be content in marketing already registered rescue insecticides. For the tobacco budworm, however, development of a number of promising new pesticides to replace DDT and other tobacco budworm insecticides is underway by the chemical companies. These products are also being field tested at agricultural experiment stations and the extension service hopes that they will be registered for the 1977 growing season. Thus, cooperation between the extension service, agricultural experiment station and chemical companies (with the farmer benefiting as a result) appeared greater in the cotton study site than in the corn study site. That is, in the corn study site the farmer was placed in a dilemma, with the extension service and agricultural experiment station indicating that rescues could not be used effectively as yet and desiring a new preventive type insecticide as an interim solution, while the chemical companies remained idle on further cutworm research and content with marketing the already registered rescue products and preventive type insecticides, although the latter did not amount to much.

As previous research has shown* and as indicated above, pesticide dealers in both study sites were found to be an important source of information to the farmer regarding pesticide usage and they (the dealers) too were in close contact with the chemical companies, (as

*For example, see RvR Consultants, Farmer's Pesticide Use Decisions and Attitudes on Alternate Crop Protection Methods, Report prepared for the CEQ and the EPA, Contract Number EQC 325, July, 1974.

well as the extension services) for information, so that their product line and advice reflected the latest recommendations.* In both study sites, promotional dinners were held in the winter for their regular customers to present their product line for the upcoming season and these meetings were thought to be very influential with respect to the pest control strategies utilized during the growing season. Moreover, in the cotton study site, some dealers offered informal scouting services to their long time customers if requested to do so.

In addition, the phenomenon of formal scouting by professionals (which included pesticide recommendations and application schedules) was widespread throughout the cotton study site. These consulting entomologists can be seen as links between state research entomologists and the individual farmer, as well as an arm of the extension service, since they are commonly former students of the LSU entomology department and have earned the respect and friendship of the state experiment staff. Moreover, the State of Louisiana has taken legislative cognisance of these professionals and regulates their activities. In contrast, scouting as an institution does not exist in the corn study site and few farmers were found to have a great deal of knowledge about scouting because they never felt the need to scout their fields given the insect problems and the availability of preventive insecticides, which were thought to be highly effective. Thus, there is evidence of a higher degree of specialization among the cotton service institutions (e.g., professional scouting) as well as more direct lines of contact to the farmer.

Professional pesticide application was also widespread in the cotton study site, whereas the individual farmer applied his own pesticides in the corn study site. When professional applicators are used, it is not uncommon for them to consult with the farmer's scout to verify application schedules and recommendations.

In the area of financial arrangements, both study sites were somewhat similar. Local banks, production credit associations and the Farmer's Home Administration (FHA) were utilized to obtain operational loans. The financial institutions usually did not request detailed information about a farmer's pest control strategy, although all expected that good management practices would be used, including the use of pesticides if past history indicated the need to. The FHA, in particular, closely supervised their customers' overall cash flow and encouraged

*Note should be made, however, that pesticide dealers in the corn study site did not stock large quantities of the recommended (or any) rescue insecticides.

the farmer to attend local extension programs. In the cotton study site, the production credit associations strongly recommended that their customers diversify their crops (i.e., plant both cotton and soybeans) and the FHA made this a requirement for the 1976 growing season in light of the poor cotton crops in previous years. Specifically related to the pesticide regulatory actions, the lending institutions have not yet reacted because they will continue to carry the farmer if loan limits are not reached and if payments are received, which apparently have both occurred.

Farmers can use their Federal Crop Insurance (FCI) as collateral when securing a loan, although FCI was not commonly bought by cotton farmers in the study site. In the corn study site, it was utilized but was not obtainable for certain crops such as milo, making this alternative crop less desirable than others.

Other institutions (e.g., marketing institutions - grain elevators, cotton buying, etc.) were found to have little influence on a farmer's pest control strategy and consequently on his adjustment response because the farmer did not have difficulty finding a local elevator to handle any particular alternative crop. Nevertheless, this is an important consideration vis-a-vis the viability of alternate crops.

Finally, the mass media (i.e., radio, television, farm magazines, farm newspapers, etc.) was highly utilized by the representatives of the various institutions mentioned above and was heavily relied upon by the farmer in both study sites for information. In particular, farm magazines were utilized by farmers for pesticide recommendations.

Overall then, it was observed that the components of the institutional network providing the farmer with information are quite different for each study site. In the corn study site, pesticide dealers, the pesticide label, farm magazines, and neighbors, friends and relatives were utilized most often for pesticide information. In the cotton study site, pesticide dealers, professional scouts, professional applicators, the extension service, and neighbors, friends and relatives were widely mentioned for obtaining information concerning which pesticides to use and how they should be applied. Indeed, cotton farmers receive information from a larger number of professional sources and this information is tailored to their specific pest control problems. Whereas the pesticide dealer in the corn study site was found to be the farmer's primary institutional source of information for pesticide recommendations supplied by the extension service and chemical companies, a number of institutions (as indicated above) were found to provide the cotton farmer with this information and at a more detailed level and on a more personal basis.

V. THE USER ADJUSTMENT RESPONSE PROCESS

In the previous chapter, a number of crop production factors and institutional arrangements and activities were described which have an underlying influence on the farmer's user adjustment response process. In this chapter, a comparison of the user adjustment responses for each of the two case studies is first presented followed by a discussion of those forces influential in the adjustment process and the important concerns for EPA.

A. Comparison of User Adjustment Responses and Problems

Presenting a comparative analysis of the user adjustment responses for the two crops and sites is made difficult by the phase difference between the two. In the case of cotton, three years have past since the DDT decision became effective. Thus, sufficient time had elapsed in order to view both the evolution and range of adjustments and problems associated therewith. For the corn farmers, the full impact of the EPA regulatory decisions has yet to be felt in that carry-over supplies of similar products (i.e., aldrin/dieldrin and chlordane/heptachlor) had not run out and therefore adjustment responses to date (i.e., as of March, 1978) had been minimal.

The problematic nature of this contrast should not be overdrawn, however, as the phase difference allows the delineation of response problems at different stages in the post-regulatory decision period. Moreover, similar user adjustment response trends that have occurred over the three year period since DDT was cancelled appear to be beginning for the aldrin/dieldrin and chlordane/heptachlor decisions. More specifically, the user adjustment responses to these regulatory actions can be categorized as follows:

- No response to the regulatory action (i.e., no reaction to the regulatory decision because the affected pesticides were not used);
- No change in current pest control practices (i.e., continued use of the banned pesticide);

- Use of new chemical pesticides (i.e., switch to alternatives to the banned pesticide);

- "Take a Chance" (i.e., attempt to grow the study crop without the use of any insecticides for the problem pest); and

- New practices to pest control, e.g.:

  - Use of early to moderate maturing varieties and/or early planting to reduce the damage from the problem pest;

  - Reallocation of crop acreage (i.e., switch to alternate crops); and

  - Intensive use of scouting with contingent use of rescue insecticides when necessary and use of other practices designed to minimize pest populations (such as beneficials, stalk destruction, etc.).

It should be emphasized that these categories are not necessarily disjoint empirically, but rather are offered as a means of conceptually organizing data from corn and cotton farmers. That is, farmers may have simultaneously exhibited more than one adjustment response described above or may have switched from one response to another.

Exhibit V.1 on the following page presents a summary of the adjustment responses and key problems voiced by farmers and other community sources as adjustment response concerns. Also presented are the derived resource contingencies underlying these response concerns, the types of farmers (from both a production/pest control orientation and a resource class orientation) exhibiting each user adjustment response and the institutional inducements for each user adjustment response. The reader should also note that throughout the exhibit, the phrases utilized were chosen so that they would (hopefully) succinctly summarize, and be reflective of, the key similarities and differences found in the two study sites.

In reviewing this exhibit, it is significant to point out that an attempt is made to associate a production planning management orientation within a pest control orientation. Although this combined orientation offers some explanation to user adjustment responses and problems,

Table V.1: Summary of Regulatory Adjustment Responses and Problems Perceived by Pesticide Users

Adjustment	Case Study I				Case Study II			
	Consequences of Key Pesticide Unit of Use by Farmers and Other Economic Sectors as User Adjustment Responses Occasion	Altered Resource Contingencies Underlying Consumers Attributes User Adjustments Responses	Types of Perceived Constraining User Adjustment Responses; Production/Post Control Dimensions	Preferences Models of Farmers Selection Unit Adjustment Responses and Institutional Indicators for User Adjustments Responses	Consequences of Key Pesticide Unit of Use by Farmers and Other Economic Sectors As User Adjustment Responses Occasion	Altered Resources Contingencies Underlying Consumers Attributes User Adjustments Responses	Types of Perceived Constraining User Adjustment Responses; Production/Post Control Dimensions	Key Data Elements of Farmers Retraining User Adjustment Responses and Institutional Indicators for User Adjustment Responses
"Adjustment" to cut [illegible]	Supply shortages and higher prices for restricted products (i.e., alaria);	Personal constraints (i.e., ability to distinguish alaria, confounding conditions: petroleum crunch) inflation.	"moderate" Advance Planning Management Orientation" (non-contingent) users of the restricted product;	Resource diseases: medium to high resource farmers; institutional indicators: extension service records; mandatory to use any corresponding supplies; knowledge of pesticide stock-piling alaria; credit sources expectations that pesticides will be used;	Supply shortages and higher prices for the restricted product (i.e., thrift);	Personal resource limitations: capital and storage facilities (inability to stock-pile) inflation;	Both "Advance Planning Management" orientation" indicators of non pest control practices and "Minimal Advance Planning Management" pest control traditionalists;	Resource disease; higher resource farmers; institutional indicators; personal ties to dealers with suppliers of the restricted product;
"Accidental" [illegible]	Supply shortages, early buying, higher prices for new chemicals and increased debt/credit problems; Local transportation and storage problems; Acquisition of equipment; Dangerous misuse;	Personal resource limitations; operating capital deficiencies; weather; not consistent; pesticide dealerships requiring permit or limit of dose of chemical; pesticide dealerships having difficulties in getting new chemicals from distributors; Confounding conditions; petroleum crunch; inflation;	"Minimal Advance Planning Management Orientation" (non-contingent users of the restricted product;	Resource disease; low and medium resource farmers; institutional indicators; advice from pesticide dealer avoiding alternate chemical (e.g., homeowners); credit sources; expectation that pesticides will be used;	Supply shortages and increased cost of new chemicals; Critical timing of applications; Uncooperative efficacy; Hoarding complications due to acute toxicity of chemistry; Increased debt;	Personal resource limitations; operating capital deficiencies; Confounding conditions; petroleum crunch; inflation; weather;	"Minimal Advance Planning Management" orientation" pest control traditionalists;	Resource disease; lower resource farmers; institutional improvements; advice from pesticide dealers; application success; and costs;
"Legal change" [illegible]	Applications may be necessary at earlier growth; Planning schedules may preclude replanting; Wasteful crop practices; replanting; The inability to replant [illegible] may increase cost liability;	Personal resource limitations; operating capital deficiencies; time constraints; Confounding conditions; weather;	"Minimal Advance Planning Management Orientation" (non-contingent users of the restricted product;	Resource disease; low and medium resource farmers; institutional indicators; dealer reluctance in stock; expose insects; older lack of suggested alternatives;	Not applicable;	Advice from the extension service, professional agents, and some dealers;	No farmers exhibited this response;	Not applicable;
[illegible]	Insurance of production technology of chemical crops; Adverse reactions to chemical crops; Increased financial risk in growing chemical crops;	Personal resource limitations; time available for cultivation of additional acres; borrowing capacity; not consistent; availability of crop insurance and marketing facilities;	"Moderate Advance Planning Management Orientation" (non-contingent and contingent users of restricted product;	Resource disease; medium to high resource farmers; institutional indicators; dealer reports of crop shortages of the restricted product;	Most would prefer to remain "conservative"; Cotton [illegible] cultivation skills; Management skills and personal satisfaction;	Personal resource limitations; operating capital deficiencies; Environmental constraints; loss of persons implied in not producing cotton; Confounding conditions;	Both "Minimal Advance Planning Management Orientation" (pest control practices) and "Advance Planning Management Orientation" (indicators of non pest control practices). The latter group temporarily [illegible] cotton [illegible] with cotton acreage to increases due to the market slump in cotton prices, the poor cotton picker in recent years, and the lower production costs [illegible] associated with soybeans;	Resource disease; high and low resource farmers; institutional indicators; credit organizations requiring crop diversification as a loan condition;
[illegible]	Land must be planted sufficient in be acute spring before planting can proceed;	Confounding conditions; weather; spring acts [illegible];	"Moderate Advance Planning Management Orientation" (both non-contingent and contingent users of restricted products;	Resource disease; high education farmers;	Land must be planted sufficient in be acute spring before planting can proceed;	Confounding conditions; weather; spring acts [illegible];	"Advance Planning Management Orientation" indicators of non pest control practices;	Resource disease; higher resource farmers; [illegible] institutional improvements; advice from extension service and professional agents;
[illegible]	Not applicable;	Problems in [illegible] pest control practices or institutional bases to study alts. Personal interactions are not stopped. The value of the approach is questioned by the extension service and agricultural chemical experts most [illegible];	[illegible]	Not applicable;	Supply shortages and increased cost of new pest control; Critical timing of applications; Uncooperative efficacy; Hoarding problems due to acutely toxic nature; attitude; Some parasitic diseases; Increased cost;	Personal resource limitations; operating capital deficiencies; Environmental constraints; losses in "some day" crop dusting services; Confounding conditions; Petroleum crunch; Institutional [illegible];	"Advance Planning Management Orientation" indicators of non pest control practices;	Resource disease; higher resource farmers; [illegible] institutional improvements; advice from pesticide dealers; extension service agents; professional agents and professional applicators;

[illegible] cotton farmers; acute to moderate cultivating varieties do not get noted;

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a farmer's resource class is also a necessary (and perhaps a more powerful) explanatory variable. That is, a farmer's personal resources -- past practices to pest control (i.e., tradition), level of financial resources (i.e., cash and/or credit), information seeking activities, sophistication (i.e., managerial skills), and friendship ties with pesticide dealers -- are linked to adjustment responses and problems. Moreover, it is important to note that various institutional activities either preclude or alleviate various responses and problems. Indeed, the magnitude or seriousness of a farmer's adjustment problems (i.e., the degree to which a particular adjustment problem affects his ability to adapt to a new pest control option with confidence), was found to be influenced by both his personal resources and the ability of the institutional network to supply timely supplementary resources for responding to a regulatory action. Thus, different problems and/or concerns voiced by farmers in adapting to a particular response can be equally serious for different farmers. For example, a farmer with good pesticide dealer contacts but poor credit may find the higher prices of alternative pesticides more serious than the limited supplies. A farmer who has good credit but lacks pesticide dealer contacts, may find the reverse to be true.

It is also significant to note that intensive use of scouting was not a response found by farmers in the corn study site nor was it suggested for future years largely because of institutional constraints and no prior use of the practice. In 1975 (the first growing season affected by the aldrin decision) most farmers interviewed either maintained current pest control practices (i.e., used carry-over supplies of aldrin) or used a new chemical (e.g., heptachlor) in a similar way. Some responded by "taking a chance" and few responded by adopting new pest control practices. However, many farmers indicated that the use of new pest control practices, specifically reallocation of crop acreage and/or "taking a chance", would increase in the 1976 growing season and in subsequent years as carry-over supplies of heptachlor and chlordane become exhausted.

In the cotton study site, those with adequate financial resources and pesticide contacts were able to stockpile DDT and maintain their current pest control strategies for at least the first growing season affected by the ban (i.e., the 1973 growing season). Once these supplies ran out, they tended to become more innovative and had by 1975 (3 years after the decision), adopted a strategy based on a more intensive use of prior scouting practices. Other farmers unable to stockpile DDT, simply began to use the new chemicals in 1973 with little

other changes and are continuing this more traditional practice today. In 1975, reallocation of crop acreage was employed by almost all farmers, particularly those plagued by financial problems. However, this response was not solely because of the DDT decision as indicated in Exhibit V, 1.

Thus, it is significant to note that the use of a banned pesticide tends to persist until the supply runs out and the supply may have been augmented by the individual farmer (i.e., stockpiling of the banned pesticide is common). When the favored (banned) pesticide is no longer available, a common first adjustment has been to simply substitute an alternative pesticide for the banned pesticide. Less likely is the adoption of new pest control practices, e.g., a major change in pest management strategy (such as intensive scouting if not used before) or a change in the crop grown.

B. Influential Forces in the User Adjustment Response Process

In the above section, a number of factors were indicated as having a key influence on the user adjustment response process.

Knowledge that a regulatory action is pending or has actually occurred is, of course, a precondition to the response process. Moreover, the current study found that such knowledge is highly correlated to the current use of the pesticide affected by the decision (e.g., aldrin/dieldrin, chlordane/heptachlor or DDT). Farmers who have never used or have not used the pesticide in recent years tend to know nothing or very little about the pending or actual regulatory action; this phenomenon was found in the corn study site but not in the cotton study site for reasons cited earlier. Those who have used the pesticide tend to know little about a pending regulatory action (unless information is supplied to them by knowledgeable sources with whom they come into contact with, e.g., the extension service); rather they hear and learn about the actual regulatory action via the news media, in farm magazines and (more so) when they come into contact with their pesticide dealer and find that carry-over supplies of the pesticide are or will be scarce.

That is, farmers do not become fully knowledgeable of a regulatory action (i.e., receive detailed information, take the message seriously and attend to it) and view it as being problematic until they

have difficulty in getting what they used to use (i.e., the banned pesticide). Therefore, farmers tend to do little experimenting with alternatives until carry-over supplies run out. Some pre-cancellation experimenting with alternatives to DDT was indicated in the cotton site, but primarily as a result of insect resistance to DDT and not the knowledge of a pending regulatory action. Hence, pesticide supply appears to be the primary stimulus for the farmer to change his pest control and production practices and not awareness of a regulatory action itself (i.e., hearing "something" about a pesticide regulatory action).

The various changes in production practices (i.e., responses) that the farmers employed have been described in Section A. Again, important considerations for the individual farmer in determining his response are his personal resources, e.g., his past practices in pest control (i.e., tradition), his financial resources (cash and/or credit), his information seeking activities, his sophistication (i.e., managerial skills), and his friendship ties with pesticide dealers. Those farmers who heard of the ban through the news media and stay in contact with information sources such as the extension service, have good dealer contacts, and have adequate financial resources,* were best able to stockpile the banned pesticide in order to maintain their current pest control practices. Indeed, some dealers contacted their long time better customers shortly after the ban was announced to warn them that carry-over supplies were tight and to urge them to place their orders early.

Those unable to stockpile or locate a source of the banned pesticide when the growing season approached was forced to adopt an alternate strategy. A farmer's personal resources and his ability to absorb a succession of poor crop years, i.e., poor crop yields, are again important considerations in the response chosen. The smaller, lower resource farmers tend to respond in the way that is least costly and least risky to their overall crop production process. This may involve simply a pesticide substitution (e.g., aldrin to heptachlor), or in some cases a crop substitution (e.g., cotton to soybeans). The latter response occurs if the crop production costs are significantly lower with another crop and if growing the alternate crop is less risky than growing the former crop without the banned pesticide. The larger, higher resource farmers on the other hand, who can more easily absorb a poor crop year will utilize alternate pest control strategies (e.g.,

*This description fits those who are typically the larger, more established and higher resource farmers.

intensive use of scouting) which are more costly and possibly more risky. However, the high resource farmers, who are more likely to take risky options than the low resource farmers, also tend to have access to a wider range of information sources and so are more likely than their less affluent neighbors to adapt in a fashion they regard as successful, regardless of the response option chosen.

However, the study found that the institutional network within which the farmer has to operate is critical both for dictating available response options as well as alleviating associated problems. When faced with replacing a banned pesticide, the farmer looks to the institutional setting to provide an answer just as he does when he is faced with a pest resistance situation. That is, the buildup of pest resistance to a particular pesticide has, in the past, initiated cooperative research activity from numerous institutions (e.g., agricultural experiment stations, extension services, chemical companies, etc.) to develop alternative pest control strategies (chemical or other) for the problem pesticide and to disseminate these alternatives to the farmer through his local information sources (e.g., the pesticide dealer). In addition, pest resistance to certain pesticides has created new institutions (e.g., professional scouting, professional pesticide application, etc.) to help in this adjustment process when necessary.

The withdrawal of a pesticide calls for this same type of responsiveness from these same institutions; however, the time factor can be more critical with a pesticide regulatory action, in that pest resistance to a pesticide is noticeable and usually evolves over a long period of time, whereas the knowledge of a pesticide regulatory action may not be known far in advance and will impact in a shorter time period. Moreover, the withdrawal of a pesticide may increase the risk of growing the crop sufficiently to warrant a crop substitution. In this case, the institutions' ability to provide services similar to those that they provide for other crops (e.g., educational information, operational loans, crop insurance, markets to sell the crop), is important if crop substitution is to be a viable alternative.

Consequently, the available response options open to a farmer and the ease with which he can adjust to a pesticide regulatory action are, most definitely, dictated by institutional responsiveness and institutional foresight vis-a-vis EPA regulatory decisions. Indeed, it appears that certain historical production conditions bearing on production related institutions of each study crop, have rendered farmers for one study crop (i.e., cotton) better able to cope with pesticide regulatory actions than farmers for the other study crop (i.e., corn).

Finally, the user adjustment response process is contingent upon noncontrollable and/or confounding conditions unrelated to the regulatory decision and the actions of farmers and organizations at the community level. For example, pesticide supply shortages caused by a petroleum crunch, inflation, weather, market conditions and levels of pest infestation, all influence both the response options open to farmers and the subsequent problems that may develop. Nevertheless, the nature of the relationships between the farmer and the various institutions will, to varying degrees, mitigate or soften the effects of these otherwise uncontrollable conditions in the production operating environment.

C. Important Concerns for EPA

In reviewing the farmer adjustment responses and problems and the influential forces associated therein, a number of conclusions are pertinent for providing EPA with a better understanding of the process associated with replacing a banned pesticide in the short-term (i.e., within a three year time period):

- Although farmers may become aware (i.e., "hear something") of a pesticide regulatory action near the time Federal decisions are made via the news media, they do not necessarily act on this information (i.e., take the message seriously, attend to it, solicit and receive detailed information, etc.). Indeed, the regulatory restriction does not become problematic until carry-over supplies of the banned pesticide become scarce. Thus, little experimenting with alternatives is done prior to this time and no preparatory or anticipatory adjustments are made.

- The initial user adjustment response amongst farmers is usually an attempt to maintain their current pest control practice and hence they continue using the banned pesticide. Indeed, many farmers augment their supply by stockpiling and are encouraged to do so through advice received in the community-based institutional service network.

- User adjustment responses that simply entail the substitution of the banned pesticide with a new

chemical are also fairly common, but the adoption of new pest control practices not utilized in the past (e.g., alternate crops, intensive use of scouting with contingent use of rescue insecticides, etc.) are met with greatest resistance by the farmer and are usually only adopted by the larger, more established and higher resource farmers in the short term.

- These user adjustment responses are not without their reported difficulties by farmers. Most of their concerns center around matters that could inhibit yield and profit; less concern for health or environmental side effects is apparent. The following user concerns are in evidence: pesticide shortages, increased cost and reduced efficacy of alternate chemicals (the latter partially caused by improper application) resulting in increased production costs, reduced yields, reduced income and increased debt; allergic reactions and the lack of institutional services for alternate crops; and institutional constraints and prior practices precluding adjustment responses involving new pest control practices (e.g., intensive use of scouting).

- Farmers look to an institutional service network in their surrounding community for alternate courses of action when faced with replacing a banned pesticide (e.g., the extension service, the agricultural experiment stations, chemical companies, pesticide dealers, lending organizations, professional scouts, neighbors, friends and relatives, etc.). However, institutional constraints which impede responsiveness to the pesticide regulatory action can preclude otherwise possible responses by the farmer.

- A farmer's past practices (i.e., tradition) and his beliefs about what kinds of pest control strategies are effective for a particular pest, influence his adjustment responses in the sense that they restrain the range of attractive options.

- Financial resources (e.g., cash and/or credit) also constitute a significant attribute with respect to a farmer's response and problems associated therewith. That is, those farmers that can weather one or two poor crop years while the community based support institutions seek viable alternatives to the banned pesticide are least likely to have serious adjustment problems.

- Noncontrollable confounding conditions such as inflation, the weather, fluctuating market conditions for alternate crops, prior and expected levels of pest infestation, and pesticide shortages caused by raw material shortages (e.g., a petroleum crunch), all influence both a farmer's response to a pesticide regulatory decision and the subsequent problems that may develop. Nevertheless, the nature of the relationships between the farmer and the various support organizations will, to varying degrees, mitigate or soften the effects of these otherwise uncontrollable conditions in the production operating environment.

- Hence, the magnitude or seriousness of a farmer's adjustment problems (i.e., the degree to which a particular adjustment problem affects his ability to adapt to a new pest control option with confidence) is influenced by both his personal resources (i.e., past practices to pest control, financial resources, information seeking activities, managerial skills, and friendship ties with pesticide dealers) and the ability of the institutional service network to provide timely, supplementary resources for responding to a regulatory action. Curiously, the extent of interphase of these two resource factors means that adjustment problems can be equally serious for different farmers in the same geographical locality.

In summary, a period of three years appears to be a reasonable definition for describing "short term" transitional user adjustment problems. This study found that during the first growing season affected by a regulatory action, many farmers will attempt to "buy time" by stockpiling the banned pesticide. For some farmers, such

stockpiles may be sufficient to carry them through the second growing season as well. However, in the third growing season affected by a regulatory action, few carry-over supplies of a banned pesticide exist and, thus, most, if not all, farmers are forced to make an additional adjustment response. Nevertheless, the available response options (i.e., alternate pest control strategies), the extent to which each is chosen, and the difficulties anticipated in adopting each option are, of course, influenced by a complex set of personal and community institutional resource conditions. Therefore, the response options open to the farmer and adopted by him in the "short term" (i.e., three years) will vary both between farmers of the same commodity sector, as well as between farmers of different commodity sectors.

VI. RECOMMENDATIONS

A. Procedural Recommendations for Pesticide Regulatory Actions

In light of the discussion in the preceeding two chapters, a number of activities should be incorporated into EPA's benefit/risk analyses (particularly those performed as part of the rebuttable presumption against registration (RPAR) process), in order to determine the localized (i.e., county level) potential short-term adjustment problems when an EPA regulatory action is contemplated.

Initially, the knowledge bases relative to the target pest, alternative pest control strategies and alternative crops in question need to be assessed as these are the critical areas that dictate adjustment responses and problems. Key factors related to the target pest are the degree to which the basic etiology and epidemiology of the pest is known by the research institutions. In addition, the real viability of alternative pest control strategies needs to be viewed in terms of:

- The financial and skill requirements for activities contrary to past practices (e.g., scouting of fields for insect damage when the practice is without history or institutional basis, use of rescue insecticides when preventive type insecticides were commonly used previously, planting of early maturing crop varieties, etc.);
- The need for services in the local institutional setting that are currently unavailable (e.g., professional scouting, professional pesticide application, chemical company incentives to market pesticides for alternative pest control strategies, stocking of pesticides not previously carried by pesticide dealers, etc.); and
- The conditions under which control of the target pest is tenuous (e.g., heavy pest infestations, pest resistance to alternative pesticides, etc.).

Furthermore, the real viability of alternative crops needs to be viewed relative to:

- Requisite skills and knowledge;
- Machinery;
- Educational information services;
- Marketing structure;
- Lending institutions;
- Crop insurance; and
- "Other" (e.g., potential for allergic reaction).

That is, in reviewing the real viability of alternative pest control strategies and alternative crops in terms of the above dimensions, an overall assessment of the existing institutional service network and the interrelationships between its components must be made vis-a-vis their activities on these dimensions, since farmers rely on this network when seeking alternate courses of action when faced with replacing a banned pesticide. Indeed, regulatory decisions must be contemplated with recognition of the fact that there are real differences in institutional and, therefore, farmer coping capacities. It is also particularly important to assess the ability for low resource farmers to adopt alternative pest control strategies or alternative crops since financial resources and the ability to weather one or two poor crop years appear important in reducing serious adjustment problems.

Once all the above assessments are made, appropriate "signals" will need to be sent to the various institutions impinging on the local agricultural community (particularly the educational and research components) when, if, and where the knowledge bases or existing activities are found lacking, so that corrective action can begin. That is, contacts in and services to the various components of agricultural institutions, including those at the county level, should be developed, so that information on impending decisions can go directly to financial institutions, county extension agents, pesticide dealers, etc., as well as to state educational and research organizations.

In addition, if "signals" have to be sent, this should be noted in the RPAR risk/benefit analysis because sufficient lead time and intensity of the "signal" are also important. For example, research on new pest control strategies for a banned pesticide can take 5-10 years

(according to estimates received in this study) if little work prior to the ban has taken place. In this instance, much lead time would be needed and a strong signal must be sent to the appropriate institutions. On the other hand, if an alternative crop is not viable simply because crop insurance is unavailable, this may be corrected much more readily.

However, simply sending these "signals" may not be sufficient to counteract a "business as usual" attitude on the part of the institutions. Thus, consideration must also be given to providing financial and technical resources to these institutions to insure that they can and will react in a way that will serve the best interests of the farmer.

Finally, in view of the 1978 amendments to FIFRA and the corresponding FY '77 appropriations in pesticide to USDA, it is not appropriate to imply that EPA "should consider doing everything" indicated here. Rather the EPA, the USDA and the appropriate state agencies should cooperatively effect the recommendations indicated above. Additional comments in this area are provided in Section B below.

B. Areas for Future Work

The preceding topics may be viewed as potential components of a model of the local agricultural system and its processes. In order to better understand the potential impact of future regulatory decisions, the development of such simulation models would be highly instructive. Indeed, the exercise of developing such a model could be as useful as the operating model itself. In turn, the learning experience during the empirical phase of this study indicates the need for further theoretical work.

More specifically, in light of the user adjustment responses and problems found in this study, a number of areas for future work that would have optimal policy benefit to EPA can be suggested:

- An understanding of why certain institutional service networks can be more responsive than others in facilitating the user adjustment response process should be determined. This study has implied that historical production conditions involving a pest that is a widespread threat to an economically significant crop for

which control has never been simple, tends to stimulate the appropriate institutional responses. This hypothesis should be further explored (e.g., a comparative study of agencies operating in various commodity sectors would be appropriate). In so doing, ways to make institutional networks more responsive can be delineated, including technical assistance and financial assistance.

- Mechanisms to promote experimentation (amongst farmers) with alternatives (chemical and other) to a pesticide that is likely to be banned should be explored so that some preparatory or anticipatory adjustments can be hoped for, rather than simply attempts to "buy time" by stockpiling the banned pesticide once the regulatory action has been taken.

- Ways to assist farmers in adjusting to the impacts of a regulatory decision (particularly those farmers with limited resources) should be explored, including technical assistance as well as financial assistance.

In pursuit of these activities, it is again not appropriate to imply that EPA should consider doing everything mentioned above. EPA, in cooperation with the USDA and the appropriate state agencies, should embark on these areas. Furthermore, to insure that each agency is participating in an optimal way, additional research may be appropriate to determine the capabilities, resources and preferences of each. Thus, EPA should explore, with the USDA and the appropriate state agencies, the responsibilities each should take in mitigating short-term agricultural user adjustment problems.

C. Methodological Concerns

In addition to the preceding recommendations, the following methodological discussion is of worth. The experience gained in the contrasting styles of work during the first week of field work in the cases of cotton and corn is instructive. That is, in the cotton case study, the two days of meetings with state level people in both the extension service and research station prior to entering the study site were very helpful for various reasons:

- The "quick education" regarding cotton culture and pest problems gave depth to information previously gained through readings;

- Having met with the "elite" served to legitimate the field team in the eyes of people at the county level; and

- Subsequent contacts with state people elicited responsive cooperation on numerous occasions.

Hence, the overall style of the first week's effort in Louisiana seems worthy of emulation in future efforts.

Moreover, the use of a very flexible ethnographic design in the current effort seems well justified in terms of two points:

- If a traditional survey research undertaking had been utilized, an understanding of the user adjustment response process would have been obscured due to the rigid nature of the research questions and the design that would have necessarily been dictated; and

- Much of the most important information (in terms of the conclusions generated) came from people other than farmers.

The conjunction of the above two points makes clear that the number of respondents will not be predictive of the quality of the results. What is important is the depth and mix of relevant data sources (including personal interviews), such that the production system and its operating environment are understood. Hence, an emphasis on gathering data concerning relevant institutions is appropriate -- which is not to say, for example, that every banker in a county needs to be interviewed.

CONSAD is confident that sufficient learning has been accrued in the process of the current study that significant efficiencies can be effected in similar, future studies.